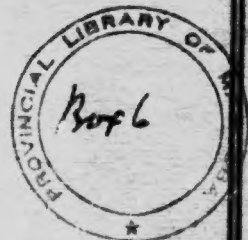


706.5.2

UNIVERSITY OF MANITOBA



THE RESOURCES OF MANITOBA
AND THEIR DEVELOPMENT



817.2.4

BY

R. C. WALLACE

Department of Geology and Mineralogy

NATIONAL LIBRARY
CANADA
BIBLIOTHÈQUE NATIONALE



PROVINCIAL LIBRARY

CLASSIFICATION

STACK

106

CASE

5

SHELF

2

NUMBER

UNIVERSITY OF MANITOBA

THE RESOURCES OF MANITOBA
AND THEIR DEVELOPMENT

BY

W. J. WALLACE

Department of Geology and Mineralogy



PRINTED FOR THE UNIVERSITY
BY SAULTS & POLLARD LTD.

1918

HC117

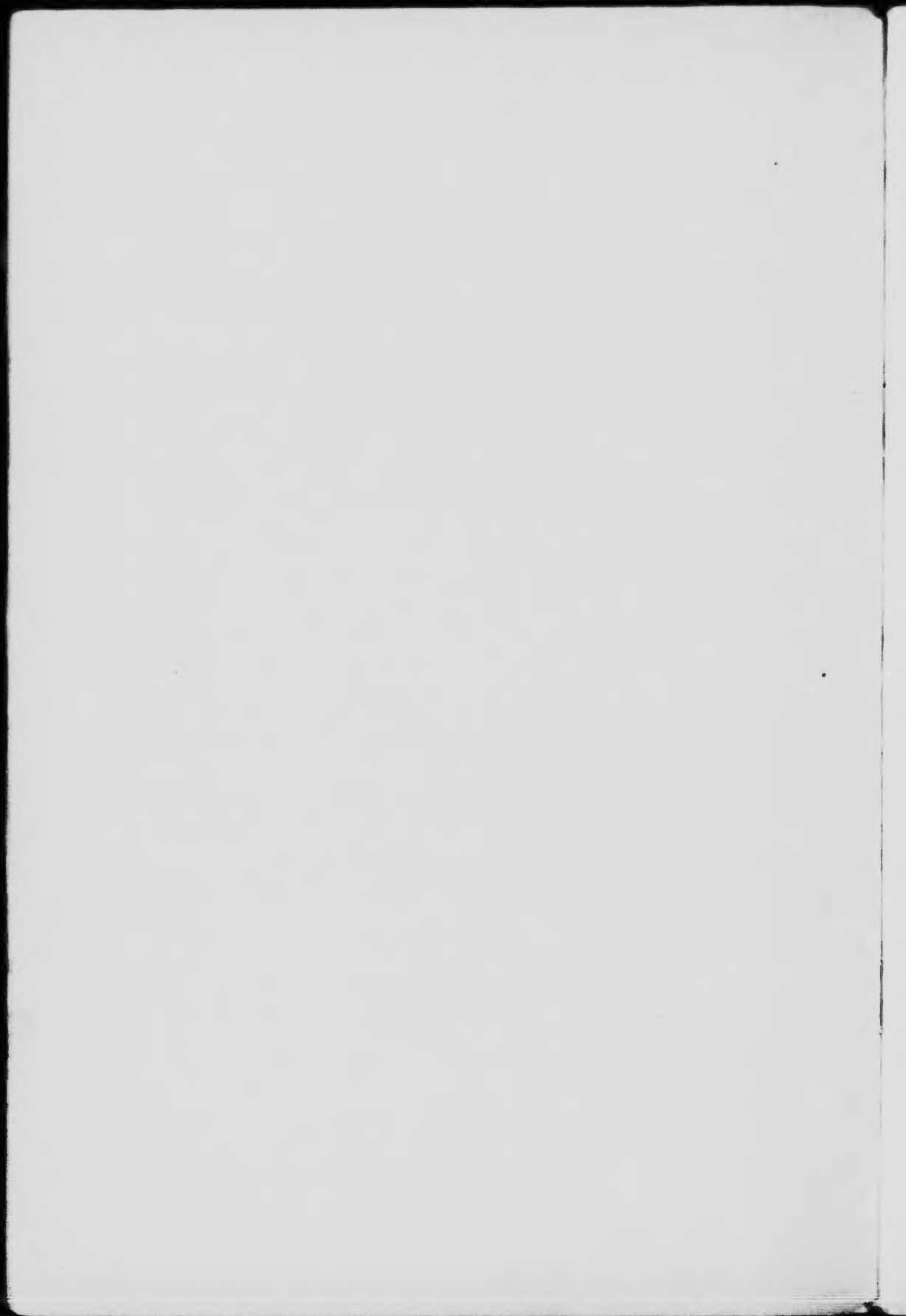
M3

N35

c. 3

CONTENTS

	Page
I. Natural Resources and the State.....	5
The Meaning of Natural Resources.....	5
Our Population.....	6
The Evolution of the Population.....	7
Climate and Human Energy.....	11
Social Institutions and Industrial Efficiency.....	13
State Administration of Natural Resources.....	15
The Situation in the United States.....	18
The Situation in Canada.....	19
Leasehold versus Freehold in Manitoba.....	21
General Policy.....	24
II. The Natural Resources of Manitoba.....	26
Production from Natural Resources for Manitoba, 1916.....	27
Agricultural.....	28
Minerals.....	32
Forest Products.....	35
Fisheries.....	38
Fur and Big Game.....	40
Water Powers.....	42
III. The Scientific Development of our Resources.....	46
The Need for Scientific Workers.....	46
Specific Problems.....	49
The Production of Fertilizers.....	49
Study of Plant Diseases.....	51
Soil Surveys.....	52
Electric Smelting of Copper Ores.....	53
The Distillation of Bituminous Shales.....	55
Work for a Biological Station.....	57
Conditions affecting Wild Life.....	59
Introduction of the European Reindeer.....	60
Fox Farming.....	61
Utilization of Water Power.....	61
The Significance of Northern Manitoba.....	62



THE RESOURCES OF MANITOBA AND THEIR DEVELOPMENT

I. NATURAL RESOURCES AND THE STATE

The Meaning of Natural Resources

To all who have given thought to the question of natural resources and their development, it has been apparent that the term as popularly understood includes only a part, and that not the most important, of the wealth of a state. Natural resources may be fairly defined as all material, whether animate or inanimate, occurring naturally within the geographical boundaries of the State, which contributes, or may be so developed as to contribute, to the well-being of the state as a whole. Under this connotation we are accustomed to think of the soil and its products, the forests, the minerals, the water powers, and the animal life of the farm, the seas, the lakes and the woods. The argument might legitimately be advanced that the men and women of the state, for whose benefit the material resources are developed and conserved, are just as truly a part of the natural resources as any other, and are indeed the most fundamentally important part of such resources. In our treatment of the subject, as developed in the succeeding pages, the population of the state is dealt with only incidentally, and only in so far as the inhabitants of any territory are necessarily the chief instruments in the development and handling of the natural resources. It is therefore advisable, at the outset, to emphasize the fact that the men and women of any territory stand first in order of importance, and that the chief concern of any state must always be the highest development of the human resources.

Our Population

The unit of territory more particularly under consideration is the Province of Manitoba. The population of the Province as determined by the official census of 1911—the year previous to the enlarging of the boundaries of the Province—was 455,614. The last quinquennial census of the Prairie Provinces (June, 1916) gave the population of Manitoba as 553,860. Of this number, almost exactly 200,000 resided in Winnipeg, St. Boniface, Brandon and Portage la Prairie. The average population per square mile of territory is therefore 2.2, while of the entire population 36 per cent reside in the four cities of Winnipeg, Brandon, St. Boniface and Portage la Prairie. While the grouping of an extraordinarily large percentage of the population of a pre-eminently agricultural Province in towns may be an advantage from the point of view of the development of civic consciousness, and while a population thus disposed is more amenable to the many influences that are so rapidly moulding the moral conscience of our Western peoples, it is nevertheless a fact of serious moment that less than three-fifths of the population are directly engaged in the first line of development of the resources of the country. It is true that the percentage of town dwellers is unduly high in Manitoba, owing to the fact that Winnipeg is a city of the three Provinces of the plains, as much as of Manitoba alone. Statistics show that 43.4 per cent of the population of Manitoba live in towns, while 39.9 per cent of the population of Alberta, and only 27.1 per cent of that of Saskatchewan are town or city dwellers. The figures should consequently be modified accordingly. But it has been recognized for the last decade that the situation is serious, and the influences which are now at work in church, school and community club to ameliorate the conditions in rural districts are a proof that not only is the situation realized, but that active steps are being taken to meet it. It is altogether improbable that any considerable number of town dwellers

will change their mode of life, and take up farming, or other out-of-doors industry; but the inducements for future immigrants will be entirely in the basic industries, and under the present system of training, the rising population of the rural districts is being educated away from the cities, and towards the country. But there are more fundamental factors involved than the absence of social amenities. The system of land tenure has resulted in large tracts of agricultural land being held for future profits; the lack of transportation facilities in the undeveloped territory has impeded the fishing, lumbering and mining industries, and the growth of population connected therewith; while the pulpwood and chemical industries which may be successfully carried on at points far distant from the larger centres, await the fuller utilization of the immense water powers of our territory.

THE EVOLUTION OF THE POPULATION

The "back to the land" movement already engages the attention of many agencies. There is however another aspect of the potentialities of our present population, which has hitherto attracted much less attention. We refer to the question of the future evolution of our mixed population. The Province of Manitoba, and indeed the whole of Canada, is fortunate in having no race problem to solve; for it may be assumed that the French-Canadian political situation in Canada will in no sense develop into an impediment to the progress of the country as a whole; and the North American Indian will always do his full share in carrying on the industries which are his by virtue of long training. There are, however, many elements, both native and foreign, in the population which have as yet remained as separate and distinct entities. At the present time the ethnologist has an exceptional opportunity to study the wealth of distinctive talent which the various units of our people have brought with them to our lands, and the new traits which the gradual co-

mingling of races has already produced. It is an opportunity which will soon pass away. Of the non-English speaking peoples which have made their home on Manitoban soil, the Scandinavians have contributed much to the community; and from their numbers it may not be considered invidious to single out the Icelanders for special mention. The closeness of blood-relationship, and the community of interest is such that intermarriage has taken place with the British stock almost from the earliest days of settlement; and today the Scandinavians are in no sense a race apart, but have become blended in the distinctively British population. It will be generally accepted that the stock has lost nothing either in virility or in intellectual ability by the process. The races of central and southern Europe—the Ukrainians, Austrians, Poles and Russians—have remained more distinct. But the stage has been reached when in the more outlying districts Galicians and British are beginning to intermarry; and another generation will undoubtedly witness the breaking down of the line of division between the mid-European units and the British element. Of the non-Europeans, the Americans are in every sense the most important element in the population, and will undoubtedly for many years form the only considerable factor in immigration. Whatever national differences may have existed before the war, these have now been swept away; and there is no longer a discrimination between the Americans and the immigrants that have come direct from British soil. Asiatics and Africans are negligible in numbers, and will in all probability remain so; though instances are known where Chinese and negroes have intermarried—strange as it may appear—with the native Indian in our Province. The best field for investigation by the ethnologist, indeed, the only one where the material is as yet at all adequate, is the race which is being gradually evolved through the intermarriage of the Indians and the British settlers during the last two centuries; and we are not aware that the subject has received anywhere the atten-

tion that it deserves. This one fact at least seems clear to the uninitiated. The Scotch or English half-breed has, in a notable number of cases, approximated more and more by marriage and by education to the British stock, and has contributed in no small degree to the community life and to the political leadership of the Province; while the French half-breed—with notable exceptions, it is true—has tended to revert to the Indian stock, and has played a much smaller part in the work of social betterment. There is now a ripe field for the study of a type of race produced by the blending of peoples very different in origin and in civilization; and this applies not only to the British and the Indian, but also—and this fact is not so well known—to the British and Eskimo in the extreme north-east part of Manitoba, and on the shores of Hudson Bay in the Northwest Territory.

There are other elements in the population which are important numerically and in themselves, but owing to religious ties have remained distinct—the French, the Jews and the Mennonites. It seems probable that for many years to come these influential units will remain separate entities, but will continue to exercise an ever increasing influence on the social and industrial life of the community.

The complexity of our population will be most readily appreciated by studying the following table and diagram, compiled from the official figures of the 1916 census, in which the origin of the people by nativity is indicated.

POPULATION OF MANITOBA BY NATIVITY, 1916

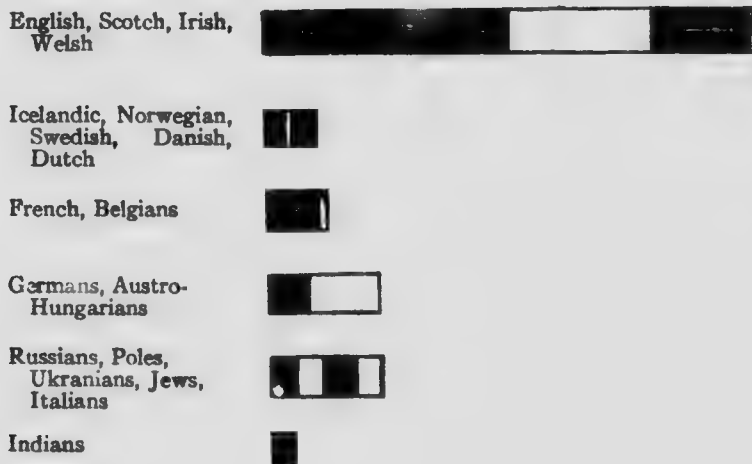
British—(English, 28.7; Irish, 11.6; Scotch, 16.9; Welsh, .5).....	57.7%
French.....	6.1%
German.....	4.7%
Belgian.....	.8%
Austro-Hungarian.....	8.2%
Danish.....	.3%
Dutch.....	1.3%
Icelandic.....	2.2%

Indian.....	2.5%
Italian.....	.3%
Jewish.....	3.0%
Norwegian.....	.6%
Polish.....	3.0%
Russian.....	2.9%
Swedish.....	1.4%
Ukranian.....	4.1%
Other.....	.9%

Of this population 3.3 per cent was born in the United States.

For purposes of diagrammatic representation, the Scandinavian peoples are grouped together with the Dutch; the Germans with the Austro-Hungarians; the Russians, Poles and Ukrainians with the Jews and Italians; the French with the Belgians; while the Indians are represented independently. The diagram will illustrate more clearly than the figures the weight of each constituent element in the population.

The Population of Manitoba, 1916



CLIMATE AND HUMAN ENERGY

The energy with which the population will carry on the industrial and commercial life of the Province is not determined solely by the inherent qualities in the races which will blend in a few generations into a common stock. It is a truism that the climate of a country is a controlling factor in the industrial activity and even in the intellectual status of its people. The Canadian West, which not two generations ago was represented as unfit for human habitation, now nurtures a population whose vigor and alertness cannot be doubted. The explanation of this apparent anomaly can be given in part at least, and is of considerable interest, both from the practical and the purely scientific viewpoints. The effects of climate on the human temperament are psychological as well as physiological, and are for that reason difficult to appreciate fully by scientific methods. A beginning has however been made in the work of reducing to an exact science the influence of the weather on human energy, both physical and intellectual; and the investigations of Ellsworth Huntington, summarized in his book on "Civilization and Climate" are of fundamental interest in this connection. Huntington obtained his scientific data by making observations, on an extended scale, on the output of work by operatives in various factories in the United States, under varying climatic conditions. He chose the factories carefully, in order to ensure that the output of work could be measured accurately, and that extraneous factors which might modify the output, be reduced to a minimum. He found that three climatic factors were dominant: (a) the average temperature; (b) the degree of humidity of the atmosphere; (c) the change of temperature from day to day. From the point of view of temperature, the best climate would seem to be one where the mean monthly temperature never falls below the mental optimum of 38° F., or rises above the physical optimum of 60° F., or possibly 65° F. Again, deficiency of moisture in the atmosphere lessens man's energy, as was

found to be the case in Patagonia, while an excess of moisture, as in Ireland and western Scotland, was found to have the same effect. A change of temperature from day to day would seem to be second only to a favorable average temperature in its influence in stimulating human energy. Such changes are most frequent in countries with a wide range of temperature, from the warmest to the coldest season of the year, and with a high frequency of cyclonic storms, both of which conditions are fulfilled in central Canada. These three factors are independent, and the most favorable conditions seldom occur together. In Manitoba, for example, if the whole Province be taken as a unit, the range of temperatures is excessive. In particular, the winter temperatures of the northern area would appear to be prejudicial to ambition and energy. Its effect is seen on the natives of the north. It is stated by Grenfell that the Eskimo "cannot compare with the Newfoundland white fisherman for perseverance and snap. An Eskimo does not get one fish for the other's ten." The humidity is also somewhat below the optimum. The bracing atmosphere of the West is apt to stimulate to a degree which may be prejudicial to the continuity of a high production of either physical or mental labor. On the other hand, in the daily variation of temperature, and the frequent occurrence of cyclonic conditions, Manitoba is very favorably situated. In order to illustrate diagrammatically the cumulative influence of the climatic factors on the peoples of the various geographical divisions of the globe, Huntington prepared a map of the world, showing the regions of "very high," "high," "medium," "low," and "very low" human energy, on the basis of climate. While for the map only a first approximation to the truth is claimed, it presents nevertheless very fruitful material for study. There are two regions of "very high" human energy: the one in western Europe, embracing the British Isles, France, Germany, Austria, Northern Italy, the southern part of Scandinavia, and extending along the Baltic Sea

into Russia; the other in the North American Continent, from the southern shores of the Gulf of St. Lawrence westwards to the Rocky Mountains, and southwards into the middle states of the Mississippi valley. Southern Canada lies well within the "very high" energy belt, which reaches its most northerly point in Manitoban territory, and includes all the area south of the Swan River district. Beyond this lies a narrow belt of "high" energy territory, and the remainder of northern Manitoba, with the exception of a small "low" energy corner south of latitude 60° and north of Churchill, is "medium" energy country. By way of contrast, it may be pointed out that only a relatively narrow strip on the south coast of Australia is "medium," and the whole of the rest of the continent is "low," or "very low." The situation is the same in Africa. The whole of India is "very low." No part of New Zealand is "very high." In a word, the scientific investigations into the effect of climate on the stimulation of mental or physical energy would appear to indicate that, all factors considered, the people of Manitoba, whether in the south or in the north, live under skies which give robustness to the physical frame, and alertness to the mental outlook. Provided the resources are available, the energy which a people can maintain is a factor that will determine the position the country will occupy in the commonwealth of nations. The population of Manitoba has not been handicapped in this respect.

SOCIAL INSTITUTIONS AND INDUSTRIAL EFFICIENCY

It is a truism that social institutions play a large part in the successful development of industrial life in any community. The church, the school, the community club, while not directly concerned with the output of labor, are factors of unquestionable importance in that connection. The higher the spiritual and ethical tone of the community, the keener the intellectual outlook, and the broader the conception of social relationships and

obligations, so much the smoother revolve the wheels of the industrial machine, and so much the more intelligent are the efforts directed towards the utilization of the raw resources of a country. More particularly in a community such as ours, with its complexity of languages and of races, do social institutions lay stress on the importance of the contributions of the individual to the well-being of the state as a whole. The work which is being carried on by the Department of Education in the non-English speaking communities in our Province, primarily with the purpose of providing an education to the children through the medium of the English language, is one of the most potent factors in operation at the present time, making for a higher efficiency of our population in the task of developing the latent wealth of the Province. A community which has mastered the English language and has learnt to think in terms of British democratic ideals, is not amenable to political trickery, and for that very reason acquires a certain independence of thought and of action. With independence comes power, and with power a sense of proprietorship in community interests. To develop resources there is needed not only initiative, but breadth of view and appreciation of the interests of the state. The school in the foreign-born communities is fitting the generation of tomorrow for the task.

There is one phase of industrial life to which the schools and University must make a real contribution, and to which educational institutions will in all probability provide the only final solution. The strife between capital and labor is world-wide; and its effects are seen here as elsewhere in lessened production from factory and mine. One is forced to the conclusion that the differences of viewpoint are fundamental, and cannot be finally removed even by the general application of the co-operative principle to industrial life. Mr. C. V. Corless, the manager of the Mond Nickel Company, in a series of articles*

* Bulletin of Canadian Mining Institute, No. 69, Jan., 1918, *et seq.*

which have been widely quoted in technical journals, and which should be studied by all educationalists, has made a very profound appeal for educational reform in the schools, in order to meet the industrial deadlock. Until the fundamental facts underlying the basic industries are appreciated by the boys and girls at school; until the principle of the interdependence of capital and labor is fully mastered; until the false distinction between the importance of the future lifework of the boy who is fitting himself for the University, and that of the boy who is fitting himself for the forge, is exposed and banished from school and University; until the civic interests which a boy or girl has already cultivated on the street or on the farm before school age are fostered and stimulated throughout the whole school course, instead of being dwarfed and even permitted to die an unnatural death, there will be no real solution to the labor problem. We are facing today a radical readjustment of educational standpoints and educational values. Already prominent educationalists in this Province and elsewhere are engaged in the high enterprise of formulating a national educational system on a much higher ethical basis than heretofore. It is not too much to hope for that the future graduates from our public schools, high schools and Universities, will have received so clear a vision of the contributions which capital and labor individually and together make to the well-being of the national life, that the selfish attitude, whether on the one side or the other, will find no longer a soil on which to flourish.

State Administration of Natural Resources

The question of the rights of the State with reference to the resources within its boundaries has seldom been clearly defined; and in actual practice the legislative control exercised by the State varies widely in the civilized communities of the world. For the sake of simplicity, let us discuss an

ideal case, where a state, hitherto unpopulated, but endowed with rich resources, is thrown open to immigrants sufficiently numerous to populate the country and develop its varied resources. Let us suppose also that the outside world clamoured for admission into this new land. It will be granted without much argument that the wise policy for the authorities of such a state to adopt, in order to promote the best interests of the state as a whole, and of the future generations in particular, would be to declare all resources to be the inalienable property of the state, to be leased, under certain restrictions, to individuals or corporations. Under such a system the authorities would always be in a position to exercise supervision over the corporate wealth of the community. They would conserve where necessary in order that the population yet to come would not suffer from the faults of their predecessors. They would prevent exploitation by the promoter with the resources as a pawn in the great game of chance. Such a community would be guided by the principle that the natural resources are, and must always remain, the property of the people as a whole, and not of any individual member of the community; that private initiative and private capital should be given free scope under a long-lease tenure, thereby eliminating the valid objections which may be urged to any system of government operation; that, in order to preserve the rights of the community at large, all such leases should be granted subject to certain conditions of operation, in order on the one hand to ensure satisfactory production, and on the other hand to prevent waste. Such would no doubt be the position taken by any government which had to deal with the situation that we have outlined. And even under present conditions, were enormous resources, such as, for instance, the copper deposits of the Coppermine and neighboring territory in the Arctic Zone, discovered within easy reach of transportation, it is more than probable that the force of public opinion would compel the government, rather than ever lease to private corporations, to operate the bonanza directly for the benefit of all the people.

The history of the growth of state communities has, however, been very different from the hypothetical case which we have outlined. Pioneer conditions are hard. Inducements must be offered in order to attract the best type of settler. At the early stage initiative and enterprise are essential, and these qualities are best displayed by the private individual and corporation. In the normal case the agricultural settler is the most desirable immigrant, and there is a deep-rooted desire in the human heart to possess the land on which the seed is sown and the harvest is reaped. For this and other reasons, the door is thrown wide open. Land is sold, given away, or alienated after certain conditions have been fulfilled. Other resources, such as timber, minerals, and even water powers, are handed over *in toto*; and a state may find itself after a lapse of a few centuries in a position where its revenue depends entirely on the indirect wealth which accumulates through the growth of commerce, and on the taxes collected on the production from resources in the development of which it has lost all control. This is a position to which not a few countries have now been reduced; and there is undoubtedly a strong movement to-day towards a return to a general leasing system of natural resources, including even the land itself. Just as in the case of the private industrial corporation, the final bridging of the ever-widening gap between capital and labor may be formed by a carefully administered profit-sharing system, so in the case of the greatest industrial corporation—the state—the people may demand that they shall be more directly than heretofore participants in the profits accruing from the development of the natural wealth of the country in which they live and labor.

As already stated, no well established general principle has guided the state administration of resources. A brief review of the situation that obtains on the North American continent will sufficiently illustrate the fact that the policies evolved by the administrative authorities on this continent show as many differences as there are administrative areas.

They are to be attributed rather to local conditions and historical situations than to well defined theoretical principles.

THE SITUATION IN THE UNITED STATES

Under the Federal law of the United States, which is applicable to the Public Land States, all resources, with the exception of water powers, are subject to alienation. At an earlier period the policy of outright sale of public lands for purposes of revenue was adopted. At present, under the Homestead Act, lands are acquired when the regular homestead duties have been performed. All mineral resources are alienated either through sale, or, in the case of minerals in quartz, after certain assessment duties have been completed. It will be gathered from the following extracts from a government publication that this policy can no longer be considered satisfactory.*

"Nearly every student of the situation is agreed that the leasing system is far better than any other for the disposal of natural resources. This conclusion is based partly on the logic of theoretical considerations, partly on the experience of other countries, and partly on the fact that the leasing system is rapidly replacing all others in commercial practice in the United States. A single instance may be cited: Over 90 per cent. of the oil production of the United States in 1911 came from leased lands. . . . It is not only with relation to mineral deposits nor by comparison with a sale system that a leasing system is advocated. Leasing should replace the present permit system, under which rights of way across the public domain are granted for reservoir sites, power development and transmission, and irrigation works. Under the existing laws the right of way granted is either in perpetuity or is revocable in the discretion of the Secretary of the Interior. Both of these conditions are undesirable—the first because the resource passes forever beyond the direct control of the public, which thus becomes powerless to guard against misuse, disuse, or monopoly; the second because the

* The Classification of Public Lands. Bull. U.S. Geol. Surv., No. 537 pp. 47, *et seq.*

capital which is required in the construction of such enterprises is not sufficiently protected. Between the grant in perpetuity, which inadequately protects the public, and the revocable permit, which inadequately protects the capital invested, lies the lease, which adequately protects both. By leasing rights of way for a fixed period of years absolute control would periodically return to the public, while the investor would be secure for a period long enough for his investment to return a profit.

"If a lease law is to be adopted, certain provisions should be incorporated in it, whether it is for a single resource or for all. In the first place, the end to be attained is not revenue for the government, but is rather the retention of control in the public. It would be a long step backward to return to the early policy of using the lands as a means of federal revenue, and any lease law enacted should be so framed as to encourage development, prohibit speculation, and add nothing to the cost of the resource to the consumer. The term of the lease should be long enough to permit profitable investment and development. It should not be longer than is necessary to furnish an adequate return on the amount invested.

"Whatever action Congress may decide to take regarding the natural resources now in public ownership should not be much longer delayed."

THE SITUATION IN CANADA

In Canada the public domain within the boundaries of the provinces of Manitoba, Alberta, Saskatchewan and the Yukon Territory is controlled and administered by the Federal Government. The provinces of Nova Scotia, New Brunswick, Quebec, Ontario and British Columbia, on the other hand, own and administer the resources within their territories. There are therefore six legislative codes pertaining to natural resources, and these codes differ in many fundamental particulars, both in principle and in details of operation. Of these, the Dominion laws approximate most

closely to what may be fairly termed the British system of control. Subsequent to the enactment of the Order-in-Council of 1917—of which more anon—whereby a long term lease was substituted for the Crown grant previously given for minerals naturally occurring in quartz, all the public domain controlled by the Dominion Government, with the exception of the land itself, may be operated only under lease. In other words, only the soil is at the present time being alienated from public control. While it may be legitimately argued that the soil is in a different category from other resources, and that a proprietary interest in land is a factor of great importance in stabilising population and increasing production, it is significant that there is growing in the West a feeling that all is not well with the administration of the land, and that some more direct measure of control than the remedial taxation of undeveloped lands is essential to the future welfare of our agricultural industry. The Lieutenant-Governor of Manitoba, shortly after assuming office, emphasized the dangers which we face under our system of land tenure. In order to illustrate the loss incurred by the western provinces from illegitimate exploitation of land, he pointed out that of 100,000,000 acres of arable land granted to homesteaders, soldiers, railway corporations, the Hudson's Bay Company, and various private interests, only one-third was being worked. In New Zealand the practice of the government is not to alienate the lands entirely, but to let them out on a long-term leasehold system, with the right to control conditions of residence and of cultivation. "A similar policy," said Sir James Aikins, "would in Canada check speculation, and ensure the use of natural resources."

In the administration of mineral resources, New Brunswick follows most closely the principles adopted by the Dominion Government, though there are numerous differences in details. In New Brunswick only long-term leases are granted, and a definite amount of work is necessary each year in order to maintain the lease in good standing. The

resources of Nova Scotia are operated under a system of either license or lease, it being permissible to transfer the license to a lease, on the application of the licensee. In Quebec there is the option of operating under a license system, which is practically equivalent to a leasehold, or of obtaining title to the property (in the case of mining concessions). A certain amount of work is demanded every year. The Government of Ontario offers fee simple title of the surface and underground of all public lands, except on certain forest areas, for the surface and underground of which leases may be obtained. The patent conveys all Crown title in fee simple, but involves the obligation on the part of the claimant to make annual reports on output, and to furnish employment statistics. In British Columbia Crown grant may be obtained, if desired, for all but placer claims, for which leases are given. It is, however, not obligatory to obtain a Crown grant, and properties may be operated under a system of annual license.

LEASEHOLD VERSUS FREEHOLD IN MANITOBA

We have discussed somewhat more fully than might otherwise have been advisable the details of leasehold versus fee simple in respect of natural resources on account of a local situation which has arisen consequent on the passing of the Order-in-Council of 1917, by virtue of which the Dominion Government adopted the policy of granting leases in place of title to all minerals naturally occurring in quartz, of which in this district gold and copper are the most important. Manitoba is more directly concerned in this change in policy than any other territory to which the federal laws are applicable. In Saskatchewan and Alberta the mining of gold and copper is as yet negligible. In the Yukon territory placer mining—to which other laws apply—is still the most important industry. In Manitoba, however, the future of the mining industry will rest with the success with which quartz claims—for copper, gold, tungsten, and other precious minerals—will be operated. It is consequently of fundamental importance that the legislative control should be of

such a nature that the industry in its infant stage should be encouraged and stimulated, and that a fair field should be safeguarded for the employment of capital from outside sources. The United States of America will undoubtedly supply the greater part of the capital on which Manitoba must depend for the development of her resources for many years to come. Under the Federal laws of the United States, as we have seen, the investor in mineral properties may obtain a title, and thus feel himself secure from interference in the development of his domain. It may be, of course, that this situation will not obtain for many years longer. In 1907, a special commissioner was appointed by Congress to investigate the actual working out of the leasehold system of mineral tenure, as practised throughout Australia and New Zealand. His report was an unqualified endorsement of the leasing system. Mining engineers, promoters and capitalists in Australia and New Zealand were practically unanimously of the opinion that their system of government leasehold of minerals, involving *bona-fide* development, was a practical success. Their verdict was all the more striking in view of the fact that in all the earlier days of mining in Australia the policy of alienation of mineral lands was in vogue; and even today in New Zealand the operator has the option of purchase, an option which is very seldom exercised. In view of this report,* and official opinion quoted in an earlier paragraph, there is at least some foundation for the belief that the Federal laws dealing with natural resources may yet be modified. As the situation now is, however, the American capitalist who is looking for favorable fields for investment abroad is accustomed to the freehold system at home. He finds that in the already established mineral territories of Ontario to the east, and British Columbia to the west, he may obtain possession outright of the properties in which he may desire to invest his capital; while in Manitoba, a field which has

* Mining Laws of Australia and New Zealand. Bull. U.S. Geol. Surv., No. 505.

undoubtedly great promise, but where the industry has not yet reached a sound footing, he can secure only a long term lease. There is a very strong feeling among practically all classes of mining men throughout the Province that, as the situation stands, it is more difficult to attract capital into mining investments than it would be were it possible to offer the security of freehold tenure. The point will later be made that the development of a sound mining industry in the Province is of vital importance for the industrial life of the City of Winnipeg, and for the commercial future of a community which can only in part be dependent on agricultural expansion; and all who are concerned that the foundations of our economic structure be truly laid, will be well advised to give thought to the conditions which this growing industry has to face.

We may perhaps legitimately assume that the force of democratic feeling is behind the system of leasehold tenure, whereby a certain measure of control is retained by the people at large. The logical consequences of adoption of a leasing system are not so generally realized. If the people retain the ownership, they must also assume the obligation that development will be assisted by all means in their power. If we rent a house, we expect that the owner will see to it that the business of living in the house is made not merely tolerable, but reasonably pleasant. On a similar basis, the Dominion Government, by adopting a leasehold in place of a freehold system for minerals naturally occurring in quartz, has thereby tacitly assumed the responsibility of assisting mineral development to a much greater extent than heretofore; and if a similar system were to be adopted by the Western Provinces when their resources are handed over, the argument would apply with still greater force. The success which has marked the progress of the mineral industry in Australia and New Zealand under the leasehold system has been in large measure due to the fact that the various Governments have shown the greatest enterprise in provid-

ing transportation facilities into new camps, in erecting Government smelters and stamp batteries, and in assisting prospecting. In Manitoba the success of the mining industry rests first and foremost with the prospector. Nothing that will hamper his activities should be permitted to stand. Apart from the question of the system of tenure, the Dominion laws are particularly favorable to him, in comparison with certain laws that obtain in the Provinces. He would be compelled to admit that the erstwhile freehold system promoted a species of real estate gambling in mining prospects, which was not in the interests of the development of a sound mining industry. If, however, he does not receive specific assurance that under the leasehold system the Government will always stand ready to assist—within its own sphere of action—in developing all prospects that show good promise of success, he is justified in view of existing conditions in petitioning for a repeal of the leasing clause.

GENERAL POLICY

The general policy of the Canadian Government, with reference to the resources of the country, has recently been enunciated in England by the Minister of the Interior. Speaking before an audience of Fellows of the Royal Geographical Society in London, on the subject of Canada's resources, Mr. Meighen made special reference to the attitude of the Government in this regard. We may fittingly conclude the discussion of this aspect of the subject by quoting his words in full:*

"A word as to Government control. Canadian industrial expansion has proceeded chiefly along lines of private initiative and enterprise. The stimulus of individual profit remains in almost every field the most potent force in our development. Every motive of honor and of interest enjoins that that stimulus be not blighted or destroyed. There is no spirit of confiscation abroad

* *The Geographical Journal*, Vol. LII., No. 2, Aug., 1918, p. 69.

among Canadian people or Canadian public men. Such of our resources as from time to time pass from the public ownership into private hands are thereafter subjected to control only that waste and the locking up for selfish and speculative ends may be avoided, and by no means that their legitimate earning power may be checked. The dictates of wise policy have suggested that our invaluable water powers—an asset of clearly distinctive character—should be to the utmost extent not only state owned and controlled, but state developed and operated. All the arguments that go to support Government monopoly apply with peculiar force to water powers. The long years that are required in the production of a forest crop render forest management also a proper sphere of Government activity. But private enterprise has and will have in Canada abundant opportunity. No just right of invested capital is now being disturbed or will be disturbed. While our people realize that in the evolution of industry the tendency is, in many spheres at least, for the units to collect, and grow larger and larger, ultimately maturing, by slow degrees, into state proprietorship and operation, still, while this is realized, there is no spirit of rampant or headlong socialism in possession of the Canadian mind. There will always be British fair play. Capital is as safe in Canada as in any country on earth."

*II. THE NATURAL RESOURCES OF MANITOBA

In the present stage of development, Manitoba is pre-eminently, and indeed almost entirely, an agricultural Province. In its historical evolution other factors have played their part. It was the attractions of the fur industry that first introduced British capital, and indirectly resulted in the Province being added to the possessions of the British Crown. A mineral asset—the salt which was won from the salt springs on the west shores of Lake Winnipegosis and Lake Manitoba—was a not unimportant factor in the industrial life of the community for a century and a half. But the colonization of the Red River valley by the Selkirk settlers, the settlement of southern Manitoba when the railway reached the upper waters of the Red River, and the immigration into central Manitoba by way of the Canadian Pacific Railway, were movements which were dominated solely by the lure of the soil. Even the phenomenal growth of the city of Winnipeg in population and commercial activity, while not to be ascribed specifically to the agricultural wealth of the Province, is, at any rate, the outcome of the wealth of the soil of the western plains. The statistics of production from the various natural resources of the Province afford the best means at our disposal to study from the comparative point of view the situation as it obtains today. The following figures are for 1916, and may be taken as fairly typical of the conditions that have obtained since the outbreak of the war. The cereal crop was much less than that of the preceding year, when a bumper harvest was reaped in the West; but the prevailing prices were high, and the actual value of production is not greatly below

* In compiling the information contained in this section, the publications of the following departments were freely utilized: The Department of the Interior (Dominion Lands Branch, Natural Resources Intelligence Branch, Forestry Branch, Water Power Branch); the Department of Naval Service; the Department of Mines; the Commission of Conservation; the Commission of Northern Manitoba; the Public Utilities Commission of Manitoba; the Department of Agriculture (Manitoba). To these authorities and to many private individuals acknowledgment is heartily accorded.

normal. The mineral output was low, owing to the small demand for structural materials.

Production from Natural Resources for Manitoba, 1916

Agriculture—

Field Crops.....	\$ 76,749,000
Stock and Produce sold.....	24,539,064

Total.....	\$101,288,064
------------	---------------

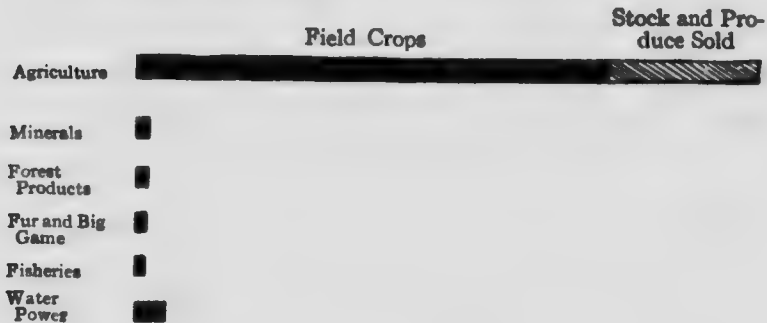
Mining.....	\$ 1,823,576
Forest Products.....	1,807,320
Fur and Big Game.....	1,684,474
Fisheries.....	1,390,002
Water Power.....	5,129,789

Total.....	\$113,123,225
------------	---------------

These figures must be taken rather as a first approximation, than as an absolutely accurate statement of total production for 1916. Dairy produce consumed on the farms is not included, as no detailed figures were available. Again, it is difficult to ascertain the value of the total catch of fur for any season. Although careful supervision is maintained, there is always an unreported residuum. The figures quoted were compiled from the returns of trappers' licenses, and may be taken as official. If the figures be accepted as the most accurate statement available of the production from natural resources for a single year, the following deductions are of interest. For 1916 agriculture was responsible for 89.5 per cent of the total production in Manitoba. The production from the actual wealth of the Province per capita of the population was \$204.24, of which \$183.05 was derived from the output of the farms, which may therefore be fairly taken to represent the only important product from our natural resources. By way of contrast, it may be pointed out that the mineral output of Ontario for the same year was \$80,379,352.

The situation is graphically portrayed in the following diagram:

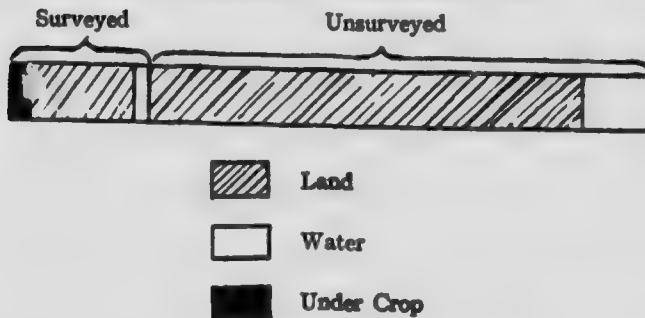
Production from Natural Resources in Manitoba, 1916



Agricultural

Of the resources enumerated above, the agricultural and the fur and big game industries stand apart in respect of the fact that the care of their development has to a large extent devolved on agencies and institutions administered by the Province. For that reason the essential facts are more clearly understood locally than in the case of our forest wealth, minerals, fisheries and water powers. On that account, too, less space will be devoted to the discussion of our agricultural wealth, in this short resume of our resources, than the predominating importance of the subject would otherwise demand. There are, however, certain features on which emphasis should be laid. Of the total area of Manitoba, (161,172,298 acres), only 35,473,601 acres are surveyed, of which 4,041,217 acres are under water. Of the surveyed land area, only 5,030,960 acres, or less than one-sixth, were under crop of any description in 1916. In other words, less than one-twenty-eighth of the total land area of the Province was devoted to the raising of crops during the year 1916. The situation will be more clearly realized by means of the following graphical representation.

The Acreage of Manitoba, 1916



A study of the significance of the above diagram leads to the conclusion that, notwithstanding the preponderance of the agricultural factor at the present stage of the development of the Province the area as yet involved is relatively so insignificant that other factors may in the future assume increasing importance.

To confine attention for the moment to the cereal crops. The acreage under wheat, oats, barley and flax for the respective seasons since 1883 is graphically represented in a diagram prepared by the Natural Resources Intelligence Branch of the Department of the Interior.* In this diagram it is shown that while there has been a practically steady increase in the acreage of the wheat, oats and barley crops, and, while the increase has been greatest for wheat and least for barley, the acreage for flax has remained almost stationary. The estimated yearly value of the four cereal crops is shown in another diagram, prepared by the same authorities.† While the acreage sown to wheat has been much greater than that sown to oats, it is of interest to note that since 1909 the value of the oat crop in Manitoba has been consistently greater than that of the wheat crop, a situation which does not hold in the neighboring Province

* Supplement to the Cereal Maps of Manitoba, Saskatchewan and Alberta, p. 5.

† Supplement to the Cereal Maps of Manitoba, Saskatchewan and Alberta, p. 10.

of Saskatchewan. The excellent cereal map, published by the Department of the Interior, shows at a glance the extent to which the four cereals were cultivated in Manitoba in the year 1915. The acreages in each township sown to wheat, oats, barley and flax respectively are indicated by the size of the circles in red, green, orange and blue. Apart from the fertile valleys of the Swan River and Dauphin districts, the wheat-growing area of the Province may be taken to be approximately rectangular, bounded on the north by the east and west line passing through the south end of Lake Manitoba, on the west by the western boundary of the Province, on the south by the International boundary line, and on the east by a north and south line passing through Selkirk. Winter wheat is cultivated in the Swan River district, and its south-eastward extension to Lake Winnipegosis. Oats are grown in all the cultivated territory, but the most favorable area adjoins the Riding Mountain, to the south and west of that eminence. Flax cultivation is most intensively carried on in the Mennonite settlement, and around the south-west end of Lake Manitoba.

On referring to a homestead map, it will be seen that there are two areas in particular into which homesteaders are being attracted—the large area between Lake Winnipeg and the foot of the Manitoba escarpment, near the western edge of which lie Lake Manitoba and Lake Winnipegosis, and the considerably smaller area between the Red River and the Archaean country to the east. The settlement of the larger area has been retarded mainly because of the imperfect nature of the natural drainage. The time that has elapsed since the waters of Lake Agassiz withdrew from this territory has not been sufficiently long to permit of the establishing of a complete system of streams, to carry away the surface waters from the clays which were deposited by the lake. Artificial drainage will be necessary, more particularly north of the Little Saskatchewan River. When the tide of immigration once again turns towards Western Canada,

Manitoba will no longer be passed over in favor of her Western sisters. The shorter haul for grain—until the Hudson Bay Railway is an accomplished fact—the uniformly good harvests which the province has enjoyed in recent years, and the growing opportunities for mixed farming, will be sufficiently sound reasons to turn the attention of the best type of immigrants to the undeveloped areas in our Province, where nature has been kind, and drainage commissions will yet be generous.

In concluding this short survey, it may be of interest to give in detail the value of the agricultural production for the year 1916.

AGRICULTURAL PRODUCTION FOR MANITOBA, 1916

Field Crops—

Fall Wheat.....	\$ 85,400
Spring Wheat.....	36,415,400
Oats.....	23,735,100
Barley.....	10,983,200
Rye.....	590,400
Mixed Grains.....	20,000
Flax.....	447,300
Potatoes.....	2,872,500
Turnips, etc.....	221,500
Hay and Clover.....	1,107,600
Fodder Corn.....	126,000
Alfalfa.....	144,300
Total.....	\$76,749,000

Stock and Produce Sold—

Livestock.....	\$11,326,457
Dairy Produce.....	9,528,789
Slaughtered on Farms.....	1,874,500
Other Farm Products.....	1,789,215
Orchard Fruit.....	5,385
Small Fruit.....	14,718
Total.....	\$24,539,064
Grand Total.....	\$101,288,064

Minerals

From the point of view of future development, the mineral industry stands high in order of importance. The production for 1916 (\$1,823,576) was considerably less than the annual production for the years immediately preceding the war, owing to the fact that the demand for structural materials for building purposes (brick, building stone, gypsum, lime, crushed stone and cements) had practically entirely disappeared. Even at the time of maximum production, however, the relative values of mineral and agricultural products was practically 1.40; while in Ontario for the year 1916 the relative values may be taken with the same degree of approximation as 1.3. In any attempt to explain the disparity between these figures, there are two facts to which weight must be attached. The settled areas in Manitoba are in the wheat belt; in Ontario, in mixed farming country, where the agricultural returns are of smaller total value per acre. Again, the mining industry in Manitoba is at least thirty years behind that in Ontario, a Province which was unusually fortunate in developing, at an early stage in the history of the industry, a mining camp which attracted world-wide attention, and produced a very efficient class of prospectors, through whose explorations other camps of equal importance have later been established. While these facts have an important bearing on the situation as it obtains today, other conditions will undoubtedly hold for the future. Of the total area in our Province, at least three-fifths will have no value as agricultural land. While the production of fish and lumber (as pulpwood) can be increased in this territory, and while in the utilization of water power great expansion will take place, it is to the mineral industry that the Province will look for returns in some measure commensurate with the size of the territory at present unproductive. In order to accomplish this end, it will be necessary to obtain the services of a much larger number of trained prospectors, to furnish railway transportation to many districts at present inaccessible,

and to effect a change in the attitude of the average man to the mining industry. So long as mining investments are looked on as gambling chances, and so long as the business man who applies common-sense principles to his business affairs refuses to take the same precautions in mining investments, just so long will there be a certain lack of solidity in the early stages of development in any camp. To throw discredit on this account on an industry which is the backbone of the development of any country that aspires to take its place in the industrial world, were as foolish as to deny the stability of the city of Winnipeg because certain sub-divisions on the outskirts of the city reaped a rich harvest for the speculator in the palmy days of the real estate boom.

Mineral products fall naturally into one or other of two classes, metallic and non-metallic. Owing to the geological structure of the Province, it is, broadly speaking, the case that the non-metallic or structural minerals are to be found in the settled areas, or rather in the areas which now are, or may become, agricultural, while the metallic ores must be sought for in the sparsely populated territory of northern and eastern Manitoba. It will be seen from the following detailed statement of the mineral production for 1916, that, until the conclusion of that year, the actual production was confined entire'ly to non-metallic products.

MINERAL PRODUCTION FOR MANITOBA, 1916.

Calcined Gypsum.....	\$191,283
Clay Products.....	104,248
Lime.....	83,754
Cement.....	794,897
Sandlime Brick.....	33,048
Stone.....	372,894
Other Products.....	243,452
	<hr/>
	\$1,823,576

The demand for building stone, brick, cement, lime and gypsum will continue to grow, as the supply of timber becomes exhausted; and the Province is well supplied with the necessary raw materials. The Tyndall building stone is acknowledged to be the best in the West; there is gypsum in sufficient quantity for all the needs of the Prairie Provinces for the next hundred years; and the supply of raw material for the Portland cement industry is very large. The figures for 1916 give no indication, however, of the activity during that and the immediately preceding years in the development of gold and copper prospects, an activity which has already, since the close of 1916, resulted in the addition of almost \$1,500,000 to our mineral production. Before gold and copper prospects in a territory far removed from transportation facilities can be developed to the stage of actual production, several years may well elapse. The figures above quoted represent only one phase, and that not the most prominent, of the mining activities during that particular year. The tangible results of the interest taken, and capital invested, in metallic mining during 1916, would be seen in the production figures for 1918.

There are now four fields in which prospects are being developed as a basis for Manitoba's future production of metals. These are the mineral belt north of The Pas, the belt on the Hayes River route, the Rice Lake area, and the Falcon-Star Lakes area. From the first, in which most real work has been done, there is already a production of copper and gold; and a stable industry in both minerals awaits only the advent of capital into the district. The exportation of copper from Schist Lake to Trail smelter has attracted widespread attention to the district as a promising field for investment not only in this continent, but among British capitalists. The prospects on Knee Lake, on the Hayes River route—a route used by the Hudson's Bay Company for over two centuries—are at too early a stage of development to warrant more than passing comment. They are fundamentally of importance in that

they will attract prospectors into a new field of considerable promise and of large extent—that Keewatin belt in which lie Gods and Island Lakes. The Star Lake field has been a centre of considerable interest for the past six years, but has not yet reached the producing stage as a mining camp. Lack of adequate transportation facilities and the inability to attract substantial capital have been to a large extent responsible for this state of affairs. With the development of a single substantial mine—and this seems now to be practically assured—there is little doubt that many of the partially developed prospects would take on a new lease of life. In this field the production would be confined almost entirely to gold. In the fourth area—that of Falcon and Star Lake—where claims were originally prospected for gold, interest has recently been taken in the possibility of the economic extraction of tungsten and molybdenum, two metals which are important for the allies in the present world combat. This field, while of limited extent, is more fortunately placed from the point of view of transportation than any of the others under review. In the short period of six years, four camps have been developed to a stage which gives great promise for future production in metals. Doubtless the next few years will not only show great progress in these camps, but will open up many new fields in the vast area which is not only unprospected, but altogether unmapped.

Forest Products

The value of the produce from our forests for 1916 stands only slightly below that of the mines. Of the total production for the year (\$1,807,320), slightly more than one-third (\$611,248) is in the form of cordwood for purposes of fuel, the remainder a somewhat more permanent asset in its use as building and structural materials. Again, rather less than one-half (\$790,592) was obtained from timber limits, the remainder was cut by homesteaders and others by special permit. The influx of homesteaders into the more northerly areas will lead to an increase in the

amount of timber cut under permit by homesteaders; but the condition of our timber resources is such that there is little probability of any very great expansion of the lumber industry in the near future from operations in timber limits in Manitoba. There is, however, one phase of the industry in which considerable activity may yet be expected in our territory. Pulp manufacture has become one of the established industries of Eastern Canada. With the possibility of the utilization of the by-products—the sulphite liquor in particular—it bids fair to become as well the mother industry of chemical activity on a large scale. In 1916 approximately half of the total export value of all forest products in Canada, or \$100,000,000, consisted of pulpwood, woodpulp and paper. To quote the words of the Superintendent of the Forest Products Laboratories of Canada: "It appears that Canada is destined to become perhaps the leading country in the world in the manufacture of pulp and paper products from wood." The pulp industry has not yet found foothold in Manitoba, but the strategic position of many of the waterpower sites in the Province—on the lower reaches of the Winnipeg River, for instance, at Grand Rapids on the Saskatchewan River, or at some suitable point—say Whitnud Falls—on the upper reaches of the Nelson River—offers opportunities for the enterprising capitalist. If with the white spruce and balsam fir, which are the staple materials for pulp manufacture in Canada, there can also be utilised, as in the United States, the large supply of poplar on either of these waterways, and if the power developed be used in part for chemical or metallurgical purposes, a foundation would be laid for an industry which would necessitate a large increase in the production from our forest resources.

The work of the Forestry Branch has hitherto been of necessity mainly preventive in character. It has been estimated that the amount of timber destroyed by fire in Canada is ten times that which has been taken out by lumbermen. In the Hudson Bay Railway area alone it was calculated that in 1915 some half million acres

were burnt over. The precautionary measures and the educational campaign which the Forestry Branch has carried out have done much to eliminate the dangers of widespread losses in the future. In this work the authorities have found it to be wise policy as well as good practice in northern Manitoba, to assign a certain measure of responsibility to the Indians, by appointing them assistant forest rangers in the Norway House district. By the policy of setting apart forest reserves on the Riding, Duck and Porcupine Mountains, these valuable stands are being conserved, and will afford a continuous supply of timber to the settlers of the district for generations to come. The idea has not yet become prevalent among the people at large that the forest crop must be treated as a resource from which an annual crop may be obtained, as from other products of the soil, and not, as in the case of a mine, an asset to be once enjoyed and then lost for ever. It is true that a crop of white spruce may take one hundred and twenty years to reach maturity. The necessity is all the greater that on such reserves as have already been logged, or have suffered from fires, replanting with white spruce or with balsam should be carried on, so that future generations may reap where we have sown, and continuity of production from non-agricultural lands may be assured for all time to come.

A detailed statement of the production from forest products in the Province of Manitoba for the year March 31st, 1916, to March 31st, 1917, is appended.*

PRODUCTION FROM FORESTS FOR MANITOBA, 1916

From Timber Berths—

Lumber (manufactured).....	\$731,858
Lath (manufactured).....	42,296
Railway Ties.....	6,823
Sawlogs (cut).....	9,615

\$790,592

* The calculations have been made on the basis of average prices.

By Permit—

Lumber and Logs.....	\$284,827
Fence Rails.....	15,590
Roof Poles.....	9,877
Fence Posts.....	31,597
Cordwood.....	611,248
Railway Ties.....	19,022
Telegraph Poles.....	4,567
Shingles.....	40,000
	<hr/>
Total.....	\$1,016,728
	<hr/>
Total.....	\$1,807,320

Fisheries

In any review of our resources, the fisheries on the inland waters of Manitoba must occupy a prominent place. The fishing industry should be looked upon as a permanent industry, which, under careful supervision, will yield increasingly valuable monetary returns. For the year March, 1916, to March, 1917, the figures are as follows:

PRODUCTION FROM FISHERIES FOR MANITOBA, 1916

Trout.....	\$ 8,813
Whitefish.....	350,543
Pickarel.....	311,262
Pike.....	204,749
Sturgeon.....	20,506
Mullets.....	21,604
Perch.....	43,015
Tullibee.....	245,925
Catfish.....	6,510
Goldeyes.....	31,610
Mixed Fish.....	143,190
Caviare.....	2,275
	<hr/>
	\$1,390,002

The total value of the fishing equipment was \$407,934, and the total number of men employed was 2,049. Lake

Winnipeg and Lake Winnipegosis are the principal fishing grounds, but many of the smaller lakes—Manitoba, Cedar, Moose, St. Martin, Waterhen, Dauphin, Sipiwesk, Wintering, Landing, and Lac du Bonnet—yield substantial returns. A feature of the fishing industry in recent years has been the northward extension of the fishing area, many of the smaller trout- and whitefish-bearing lakes having been rendered accessible by the Hudson Bay Railway. To what extent production will be increased when the railway to Hudson Bay is completed, only the most imperfect estimate can yet be made. There is no doubt that owing to accessibility to the markets at Winnipeg, and in the south, impetus will be given to the development of the fishing of the whitefish and the so-called salmon, and it may be that a cod industry will be established in the eastern waters of the Bay. The fact seems clear that the supply of fish in all our lakes is much smaller than in the time of the early voyageurs; especially is this true in the case of the sturgeon. The efforts of the fishery authorities have been continuously directed to the restoring to the lakes their former wealth in fish. The policy has been at once preventive and remedial. On the one hand, summer fishing has been much restricted. On some lakes, such as Lake Manitoba, summer fishing is not permitted. On others—Lake Winnipegosis and Lake Waterhen—open water fishing is only permissible for one and a half months in the fall. Legislation has been enacted to increase the size of gill-net that may be used, so that only the larger fish may be caught. On the other hand, a system of restocking by means of whitefish and pickerel hatcheries is being carried on in Lake Winnipeg and Lake Winnipegosis. Not only are the results of this policy of restocking apparent in the larger waters on which the hatcheries are situated, but many of the smaller lakes are being restocked by distributing to them the fry from the hatcheries. In this way, summer resorts in our forest reserves on Turtle, Riding and Duck Mountains, will be made more attractive to the many followers

of Izaak Walton; and the introduction of bass into several of our lakes would attract as well visitors from far afield. The time is not far distant when the restocking of the Saskatchewan River, and the many lakes in the north country tributary to that great waterway, will have to be seriously considered; and the whole question of revitalizing the sturgeon industry in the northern waters demands immediate attention. The fact must not be overlooked that the staple permanent industry of the north will be the fish business. Mining may attract much more capital and a much larger population, and may produce a much larger revenue. But a mine is a non-permanent asset. Our lakes and rivers will under careful protective measures give a permanent yield, and support a stable population. To the Manitoba Fisheries Commission of 1910-11 must be attributed in great measure the effective legislation which is now in force for the conservation of our fisheries.

Fur and Big Game

In order of historic importance the fur and big game industry ranks first among the industries of Manitoba. Had it not been for the harvest of furs, which the region tributary to Hudson Bay bade fair to produce, the history of Canada might have been different, and the British might have had no claim today to one of their choicest possessions. As settlement moves northward, and mining industries gain foothold, fur-producing animals and big game gradually disappear. It can hardly be expected, even under the most favorable conditions, that this industry can hold its ground if other industries are to prosper. As it is, the Province is unusually well supplied with a very diversified fauna. The Chief Game Guardian, in his report for 1917, makes the following statement: "It is becoming a recognized fact, not only at home, but also abroad, that Manitoba possesses the richest and most diversified heritage of wild life of any Province in Canada, or possibly any state in the Union to the south." While it is somewhat difficult, under present

conditions, to get a full statement of the total catch of furs in the Province for any single year, the following figures, calculated from the official returns for 1916, will give an approximate, though no doubt very conservative, indication of the value of the furs obtained:*

PRODUCTION FROM FUR AND BIG GAME FOR
MANITOBA, 1916

Furs—

Otter.....	\$ 54,880
Beaver.....	221,100
Mink.....	87,420
Fisher.....	38,500
Skunk.....	11,720
Marten	105,400
Muskrat.....	522,900
Wolf.....	217,900
Bear.....	20,380
Fox.....	205,570
Lynx.....	39,420
Ermine.....	25,250
Wolverine.....	1,570

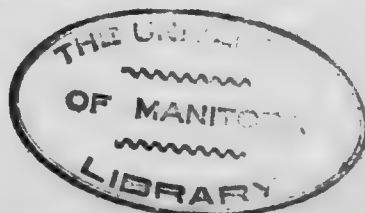
\$1,552,010

Big Game..... 132,464

Total.....\$1,684,474

In order that this heritage of wild life be conserved, the game laws provide for the protection of such animals as may be in danger of extinction, by shortening the open season, or even eliminating the open season altogether; and game preserves have been set aside from time to time as sanctuaries where wild life is held inviolate. Such precautionary measures have not been adopted too soon. The buffalo has disappeared; the elk is seriously reduced in numbers; the beaver was in danger of extermin-

* The calculations have been made on the basis of average prices.



ation in the southern half of the Province a few years ago; those valuable fur-bearing animals, the fisher and marten, are now very scarce; while prairie chicken and spruce partridge have been much reduced in numbers in the past few years. To what extent such vicissitudes in wild life are periodic, and independent of man, has not been clearly established. But it has been demonstrated that legislative control of the trapper's activities is necessary, in order to maintain wild life in reasonable abundance; while by setting apart game preserves, and by carefully patrolling these preserves, sanctuaries are being provided to which the animals of the woods will gather for protection, and from which there will, in time, go out a stream of life, sufficient for the needs of the sportsman and the trapper. The game preserves of the Riding and Duck Mountains will for all time afford protection to one of the noblest of the wild animals of the Province—the wapiti or elk. It would indeed have been a sad reflection on our appreciation of the value of our wild life were the elk permitted to follow the buffalo into the limbo of the things that are no more.

Water Powers

Of all the natural resources with which a country may be endowed, there is one, and only one, which constant development will not diminish, nor will conservation increase. It is significant for the future industrial position of Canada that she is so plentifully endowed with water power. In a recent report of the Water Power Committee of the Conjoint Board of Scientific Societies of Great Britain, prominence is given to the fact that Canada possesses at least 18 millions out of the 50 to 70 millions of horse power, estimated to be the potential water power of the whole Empire. There is, moreover, a wise economy in the distribution of water power in the Dominion. In central and north-eastern Canada, where fuel resources in the form of coal are not available, hydraulic power is especially abundant. It has been

calculated that one horse power per year is equivalent in energy to $\frac{1}{2}$ tons of coal. On this basis, even with the relatively small amount of power developed in the Province of Manitoba, there is a yearly saving of 380,000 tons of coal, an item of no small importance in view of the rapidly decreasing supply of coal available for this continent. From the results of investigations conducted for the Commission of Conservation, the following values for the available horse power in the Province have been summarized:

AVAILABLE WATER POWER IN MANITOBA

	Horse Power
Nelson River.....	2,904,500
Churchill River.....	184,900
Hayes River.....	28,560
Winnipeg River (minimum regulated)	555,900
Saskatchewan River.....	56,400
Berens River.....	23,340
Pigeon River.....	33,180
*Other measured power.....	55,240
	<hr/> 3,842,020

Of this grand total, only 76,200 horse power is developed, as shown in detail below:

DEVELOPED WATER POWER IN MANITOBA, 1916

Pinawa Channel (Wpg. Elect. Ry.).....	28,200
Point du Bois (City of Winnipeg).....	47,000
Minnedosa River (Brandon Elect. Lgt.)	800
Minnedosa River (Minnedosa Power Co.).....	150
Shell River (Asessippi Flour Mill).....	50
	<hr/> 76,200

* Grassy and Burntwood Rivers not included.

In actual value, the production from water power in Manitoba for the year 1916 is as follows:*

PRODUCTION FROM WATER POWER IN MANITOBA, 1916

Winnipeg Electric Ry. Co.....	\$3,019,924
City Light and Power.....	2,054,472
Brandon.....	48,244
Minnedosa.....	7,149
	<hr/>
	\$5,129,789

It would be a wrong interpretation of the figures which have been quoted, were it assumed that Manitoba had a resource of practically 4 million horsepower which would in time represent an equivalent of 20 million tons of hard coal per year. The greater part of the hydraulic power is on the Nelson River; part of this may serve to supply the motive power on the Hudson Bay Railway when the grain traffic is developed, and part to supply the mines and smelters and chemical industries which may need such power; but it is unreasonable to suppose that any considerable percentage of that vast power reservoir will ever be tapped. Again, the development of waterpower must be considered in its relationship to other resources. Were agricultural interests to suffer because of the jamming back of our greater watercourses, it would be unwise to use the power. Even when viewed from this broadest standpoint, however, it will be realized that there is as yet unused in the Province a source of energy which will have the most far reaching effects in directing the course of our industries in the years of keen competition which have to be faced in the not far distant future.

Such, in briefest outline, is the situation that obtains today in so far as the utilization of the real natural wealth

* The calculations were made on the basis of lighting rates.

of the Province is concerned. While in some departments it represents the results of a hundred years of endeavor, it is to be considered on the whole as a stock-taking after 40 or even only 25 years of business, where the working staff numbers no more than two individuals to every square mile. In the various fields of activity that have been discussed, there is clearly abundant opportunity, and, with the conditions that now face us, urgent need, for expansion on a generous scale. It is equally manifest that the development of any one field cannot be contemplated in disregard of the ultimate welfare of the other industries. Deforestation will reduce hydraulic power and destroy soils. Mining may lay waste forest areas, and rob the wild life of their natural habitat. Pulpwood and chemical industries may seriously affect the life of our lakes and streams. Even the soil may be sacrificed in order to acquire the necessary surface area for mining operations, or to secure more abundant reservoirs for power. As rival interests grow in strength, they will come more directly into conflict. It will be well if at the initial stage of the expansion of our industries there be struck the note that the rights of the interests vested in the individual natural resources of the Province, however important they may be, must subserve the greater interest of the whole people in the sane development of the public domain.

III. THE SCIENTIFIC DEVELOPMENT OF OUR RESOURCES

In order that the British Empire may recover from the financial strain which the burden of the war has imposed, it will be necessary to develop the latent resources of the Empire much more rapidly than would otherwise have been found necessary. If the war lasts till the end of the winter of 1918-19, Canada will be faced with a debt of nearly one and a half billion dollars and an annual budget of three hundred and fifty millions, to be met by increased taxation in every form.* It is imperative that every available avenue whereby the potential resources of the country may be transformed into actual wealth should be thoroughly explored. The duty is laid on the provinces to contribute their quota to the total revenue; and to stand prepared for the pitiless struggle which cannot fail to come when the whole civilized world attempts to shake off its incubus of debt by herculean efforts to develop such industries as each nation, by geographical situation, or by national temper, may be individually competent to foster.

The Need for Scientific Workers

It is because of the lessons which the war has taught that it is no longer necessary to adopt the apologetic attitude in asking for the recognition of science. The whole British Empire realises that without the application of the results of scientific research to her industries after the war, economic supremacy will be lost for all time. It is, however, still necessary to emphasize the fact that a system of protective tariffs for the growing industries of the Dominions under the British Crown is fraught with exceeding great danger if under its shelter the industries are not compelled to maintain staffs of research workers as almost their first line of battle and of defence. To quote from the first Annual Report of the Chairman of the Advisory Council for Scientific and Industrial Research,

* This may now be modified (Nov. 11, 1918.)

an organization which is in itself a proof that the nation now realises the importance of science in industrial life: "The new era which is about to begin for Canada is one whose industrial problems are to be of such magnitude as to compel a radical recasting of all our industrial methods, and above all, of the attitude of the Governments, Dominion and Provincial, on the one hand, and of those in control of the industries, on the other, regarding the claims of scientific research as an all-important factor in the promotion of industrial development."

It may be assumed that the general principle which has been enunciated will find wide acceptance. It is unnecessary to present it from any other viewpoint. The practical situation which confronts us, however, is the application of the principle to the special problems of the Province. It is fundamental that there be well trained scientific workers in sufficient numbers to deal with the industrial problems that await solution. The Advisory Council for Scientific and Industrial Research offers scholarships and fellowships for science graduates who may be competent to undertake special research investigations which may have an economic bearing. This will result in more of our science graduates receiving their early training in research in our own Universities and in the environment of their local industrial and scientific problems. But graduate research workers can only be obtained if the supply of undergraduate students in science is ample. In the west until very recently, the traditional value of the degree in arts has been so highly esteemed that few students were willing to enter on a course leading to a degree in science. If science was studied at all, it was taken in an emaciated form as part of a course for a degree in arts. The annual budget for all the departments of science in the Universities of Canada does not in total equal that of the Massachusetts Institute of Technology. This fact in itself proves that the value of a training in science for its own sake and because of its service to the

community has not yet been practically approved by the educational authorities. The writer would yield to no one in his appreciation of the cultural value of the humanities as an educational instrument. He would contend equally firmly for the cultural value of the natural sciences, and in particular for the mental training and discipline which the investigator obtains. He would also point out the urgent necessity, from the practical point of view, that sufficient students be trained in our Universities in pure and applied science, and that courses be maintained which will ensure that the students who graduate have obtained sufficient insight into the fundamentals of the sciences to enable them to carry on independent work in problems in pure science or in its application to the industries. Specialization may have its defects: but there are times in the affairs of nations when the knowledge of the specialist is indispensable. There is already an indication that our young men and women realise the opportunity that the future holds in store for the trained scientist in the work of developing the Canadian West.

It has been shown by the argument of figures that Manitoba is as yet almost exclusively an agricultural province. The city of Winnipeg has reached its present status owing to the agricultural development of the west. The business of the soil will increase, and Winnipeg will be affected thereby. But only as an industrial centre will Winnipeg ever reach the position of a large city. For industries to flourish, raw materials must be available, and such materials must be supplied—in the main—from our mines, forests, lakes or soil. The future of Winnipeg as an industrial centre will depend to a very large extent—cheap power and abundant water notwithstanding—on the success with which those resources whose development is as yet in its infancy may be utilized to produce in the factories the finished articles which form the basis of commerce and the most certain source of revenue that a nation may possess.

Specific Problems

To turn to the specific problems that are associated with the utilization of the natural resources latent in the Province of Manitoba. It is an easy matter to give a fairly long list of such problems; but it will be possible to deal with only a few in any detail. The study of plant diseases, and the breeding of disease resisting cereals—in particular, rust resisting wheats; the increasing of the yield per acre by fertilizers, and the manufacture of such fertilizers; the survey of the soils; the possibility of smelting the copper ores in Northern Manitoba by the electric furnace; the concentrating and milling of certain tungsten ores; the distillation of oil shales on the Manitoba escarpment and the Pasquia Hills to produce a liquid fuel and a fertilizer; the re-forestation of wooded areas with white spruce and balsam; the re-invigoration of the tamarack; the study of the life history of our freshwater fishes—in particular, of their food supply; the possibility of restocking the northern waters with sturgeon by means of hatcheries; the conditions underlying the periodic fluctuations in the life of the woods; the wolf menace; the introduction of the European reindeer into northern Manitoba; the fox farming industry under local conditions; the study of chemical industries which could be successfully operated by water power in Manitoba—such as the winning of fertilizers from the nitrogen of the air; the best conditions for a pulp industry: the feasibility of establishing communication between the posts in the north by means of small wireless plants; the use of the hydroplane for surveying by camera, and for general exploration and prospecting. These and many other problems await the investigator; and our forward progress in the industries is dependent on their satisfactory solution.

THE PRODUCTION OF FERTILIZERS

"The land on the western prairies and many other parts of Canada and the United States is at the present time being mined, not farmed. The Committee on Lands

of the Canadian Commission of Conservation, under the able chairmanship of Dr. J. W. Robertson, is now carrying on an agricultural survey of the Dominion. They visited and examined, in 1912, 1212 farms in the several provinces of the Dominion, and while in the eastern provinces, speaking generally, from 25 to 50 per cent of the farmers showed an increase in the yield of their farms during the past 10 years, of the hundred farms examined in Manitoba, not one farmer reported an increase in the yield per acre and 46 per cent reported an actual decrease. This decrease, as Dr. Robertson remarks, must be concurrent with exhaustion of fertility."¹ The basic industry in Manitoba is faced with a serious situation which is only in part to be met by the adoption of mixed farming. Notwithstanding the boasted fertility of our wheat belt, it will be seen from the diagram reproduced below that the yield per acre from the western belt is very much below that from countries where the soil has been cropped for centuries.*²

Average yield in bushels per acre of wheat in the principal wheat-growing countries of the World

(Average of five consecutive years 1909-1913)

United Kingdom	31.9 bushels
Germany	31.8
Austria	20.2
Canada	20.0
France	19.1
Hungary	18.8
United States	14.6
Australia	13.2
British India	11.9
Russia	10.8
Argentina	9.9

¹ * The National Domain in Canada and Its Proper Conservation, p. 13. F. D. Adams (Commission of Conservation, Canada, 1915).

² * Supplement to the Cereal Maps of Manitoba, Saskatchewan and Alberta, p. 13.

Not only will it be necessary to adopt mixed farming on an extensive scale, but the time is not far distant when the soil will require fertilizers in order to restore the chemical ingredients which have been lost by continuous cropping. Insofar as the restoration of nitrogen compounds to the soil is concerned, the artificial fixation of atmospheric nitrogen will undoubtedly prove the most suitable means of providing the large quantity of fertilizers which will be needed to replenish the soil of the western wheat belt in the near future. The annual world consumption of fertilizers is approximately 6,000,000 tons, and this may be doubled in the next twenty years. It would require 4,000,000 horsepower annually to produce by the cyanamide process the equivalent of 12,000,000 tons of fertilizers. That amount Manitoba possesses. It would, in other words, be possible to produce in Manitoba with no diminution to her natural resources, except limestone, enough fertilizers to supply the needs of the whole world. It would of course be impracticable to build up an industry on such generous proportions; but there can be no doubt that Manitoba is the natural location for the production of fertilizers by the fixation of atmospheric nitrogen not only for the wheat belt of western Canada, but for a large part of the wheat-growing area of the northern Mississippi valley as well. Four-fifths of the supply of nitrogen has hitherto been produced from natural nitrate deposits, mainly from Chili. These deposits are rapidly being depleted. The production of fertilizers by a system of nitrogen fixation will soon become, on this continent, a matter of vital importance.

STUDY OF PLANT DISEASES

The loss due to diseases of plants—cereals and trees—has been so large that it is a matter of urgent necessity that such diseases be fully studied by plant pathologists, in order if possible to prevent their recurrence. Owing to the prevalence of rust, smut and root rot in 1916, there was a direct loss, it has been estimated, of 100 million bushels

of grain in the Canadian west in that one season alone. The money expended at the present time in the western provinces in the study of these diseases is not more than a few thousand dollars every year. If by the efforts of the plant pathologist the spread of the disease could be prevented, or if by the combined researches of the plant pathologist and the plant breeder a rust resisting variety of wheat, suitable for the climate, could be produced, there would result therefrom a saving of millions of dollars annually to each of the wheat-growing provinces of the west. From the financial point of view, it is overwhelmingly clear that the importance of the situation has not been grasped. Not only cereals, but forest trees as well, are a pertinent subject of study. The tamarack of our forests are in a very bad condition. Only in very limited areas do they show signs of life. While the tamarack is not one of our most important forest trees, the damage which it has suffered has resulted in considerable loss. The pine blister disease, while of relatively little consequence in Manitoba, cannot be neglected. And from time to time pathological conditions may arise in field crop and forest tree which the trained pathologist at work in this field may well be in a position successfully to counteract.

SOIL SURVEYS

The soil surveys carried on in the United States have been of great value to the agricultural population. Soils are disintegrated rocks, and their distribution in any region is the result of geological processes which are fairly well understood if the geological history of that region has been correctly interpreted. If the origin of the soil is known, its chemical composition and physical characteristics can frequently be mapped with a degree of certainty. The work of soil survey therefore demands the co-operation of the agricultural chemist and the geologist. A careful investigation and mapping of our soils in the agricultural belt in Manitoba is long overdue. Not only would such a survey be of assistance to the population already

on the soil, but in the areas where settlement is in progress, and where immigrants will take up homesteads in the future, soil maps would be of great value. The undertaking is a large one, and it will be many years before a complete map of the soils of the Province can be completed; but it is satisfactory that a beginning has now been made.* The work deserves the support of a Province in which nine-tenths of the production is from the soil.

ELECTRIC SMELTING OF COPPER ORES

A formidable obstacle to industrial progress in Manitoba is the high cost of coal. More particularly is this the case in the northern territory, far removed as it is even from the soft coal of the western plains. Deposits of copper sulphide of large extent and great value have already been located in northern Manitoba. Their development on a large scale will initiate a new era in the industrial life of the Province. Some lenses of the ore are sufficiently rich to admit of shipment to Trail, B.C., involving a haul by wagon of 40 miles, by river of over 100 miles, and by rail of 1,500 miles. Only with the present high price of copper would it be possible to handle even a very high grade ore in this way. In the main the sulphide ore is low grade, and can only be operated when smelters have been erected in the vicinity of the mines. The high price of fuel, transported to the mines, whether in the form of hard coal, coke or briquettes, constitutes a financial difficulty that need not be minimized. Under such circumstances the question naturally arises whether it may not be possible to utilize the hydraulic power so plentifully distributed through the north country, in place of fuel, for the smelting of the ore. The question in our opinion introduces one of the most important problems facing the investigator who is concerned with the application of scientific research to the industrial progress of

* During the summer of 1918 a preliminary soil survey of South-western Manitoba was carried out by the late Professor Galbraith, of Manitoba Agricultural College.

the Province. Were a School of Mines established in connection with the University—a step which the position of the mining industry would hardly have justified in the past—the problem would undoubtedly be dealt with there on account of its local application. Electric smelting of certain types of iron ore has been carried on successfully in Sweden and elsewhere. Electrical processes have not been invoked in the reduction of copper ore, except in the final stage of electrolytical deposition of refined copper. Considerable experimental work has, however, been carried on by the Bureau of Mines of the United States, though not on an industrial scale. In initiating such investigations, it was felt that there was little probability that electrical power would displace coal or coke for purposes of copper smelting in districts where fossil fuel was plentiful and reasonably cheap. The question to be solved was twofold: is electrical energy a satisfactory source of heat in the metallurgical processes involved in the smelting of copper sulphides? and is the cost sufficiently low, where water powers are available, to enable smelters to operate at a profit? Without going into details, it may be stated that the answer to both questions was found to be an unqualified affirmative. A matte was produced in the closed electric furnace (with carbon electrodes) equal to the product of the blast furnace. With regard to costs, while it is somewhat unsafe to argue from the results of experimentation on a small scale, the conclusion was reached that with the cost of electrical energy at \$16 per kilowatt year, and coke at \$9 per ton, the cost of energy for smelting copper sulphide ores would be independent of the method adopted. Under such conditions, there would seem to be a very favorable field, in our northern copper deposits, for the introduction of the electric furnace on a commercial scale. To quote from the report itself: "As a result of their investigations, the writers are convinced that experimental work on a larger scale would lead to the development of an electric blast furnace, which in some cases

could be used to better advantage for smelting sulphide ores of copper than the combustion blast furnace."* We trust that in the laboratories of the Mines Branch at Ottawa, where results of great value to the development of metallurgical processes have already been obtained, this problem may be developed on an industrial scale.

THE DISTILLATION OF BITUMINOUS SHALES

Reference has been made to the scarcity of fossil fuel in Manitoba. The commendable energy with which the Advisory Council for Industrial and Scientific Research has taken up the investigation of the briquetting of lignite need only be referred to here. The results, if successful, will be of great importance to Manitoba, and to Winnipeg in particular, but the raw materials will be taken entirely, or almost entirely, from without the bounds of the Province. The subject is to that extent alien to the present discussion. There is a fossil fuel in the Province, the possibilities of which have not been adequately examined. On the escarpment which flanks the western edge of Lake Manitoba and Lake Winnipegosis, and of which the Riding, Duck and Porcupine Mountains are the most prominent elevations, there are bituminous shales which may prove to be sufficiently rich to form the basis of an oil distillation industry. Because of our geographical situation, it is important that no possible source of addition to our limited fuel supplies should be overlooked. The distillation of oil from bituminous shales has long formed a profitable industry in the valley of the Forth, in Scotland, where the raw materials seldom yield more than 30 gallons of oil to the ton, and where shales are regularly treated, whose yield is only 15 or 20 gallons to the ton. A specimen taken from the Pasquia Hills in Saskatchewan—on the northerly extension of the escarpment—yielded 40 gallons to the ton, and 35 pounds of ammonium sulphate. There is little doubt that the yield

* The Smelting of Copper Ores in the Electric Furnace; U.S. Bureau of Mines Bull. 81, p. 76.

would be greater from material less subject to surface alteration; and that equally rich shale will be found in the bituminous horizon in Manitoba. As a preliminary, detailed geological investigations will be necessary. To those who are interested in the industry a note of warning may perhaps be sounded. Notwithstanding the fact that on this continent some 55 million barrels of oil were used in 1917 in excess of the actual production, an oil distillation industry could only be successful, even under the most auspicious omens, if conducted on a large scale. Mr. George, the State Geologist of Colorado—a state where oil distillation may reach large proportions—has calculated that a plant with less than 1000 tons capacity per day could hardly hope to succeed. For such a plant an initial capital expenditure of \$2,500,000 would be necessary. It is clear that the project can only be entertained in quarters where considerable capital is available. If the industry were successfully established, the main by-product—ammonium sulphate—would undoubtedly in the years to come find a ready market in the western plains as a fertilizer.

The foundation for all progress in mining industries is an accurate knowledge of geological structure. It may not be out of place to emphasize, in this as in other fields, the value of purely scientific research in industrial development. Officers of the Geological Survey of Canada have carried on purely scientific investigations in various parts of Manitoba for many years, and have been responsible as well, often under considerable difficulties, for the geographical mapping of all the explored territory in the more northerly fields. It is the verdict of prospectors and mining men alike that the study of the structure and ore relationships in any mining district must precede the intelligent development of that district. Before the mining community, at least, it is no longer necessary to plead for the rights of scientific research.

WORK FOR A BIOLOGICAL STATION

In 1909 there was appointed by the Government of Canada a commission of three members, two of whom are resident in Winnipeg, to enquire into and report on the conditions and requirements of the fisheries in that territory which now constitutes the enlarged Province of Manitoba, in view of the fact that the necessity appeared for a complete revision of the fishery regulations. The findings of the commission had naturally to do, in large measure, with matters of legislative control; and the laws have since been modified to conform with those findings. In one very important matter, however, the unanimous feeling of the members of the commission has not yet found expression in Government action. In view of its importance, we take the liberty to quote the recommendation of the commission in full:*

"The commission have been continually impressed with the absence of accurate information, both as to the habits, growth, the food and other points in the life history of the valuable fishes which have abounded in the waters of Manitoba. The determination of the movements of the fish, of the feeding grounds and spawning resorts of the whitefish, pickerel, sturgeon, goldeye, and other commercial species, could be readily accomplished if a biological station were founded on Lake Winnipeg, or at some suitable place. The views of experienced fishermen are most contradictory on such important matters as the size at which whitefish first contain spawn, or reach the mature breeding stage. The food of the whitefish seems to be a matter still in doubt in the minds of most of the practical men, and as an example it may be stated that a bottle of aquatic organisms was sent to the chairman of the commission as probably food of whitefish, which was wholly different from the food of that fish as studied in eastern lakes. The question of the grey-backed pickerel is another matter which came before the commission,

* Report and Recommendations, Manitoba Fisheries Commission, 1910-11, p. 33.

and witnesses claimed that it was a diminutive fish, and never reached any size, while others held the opinion that it may be the young of a larger kind of pike-perch. The food and spawning of the sturgeon are important matters to decide in Manitoba waters. All these points can be decided by exact biological study, and the time seems opportune to provide for the Province such a station for scientific and fishery research as the Dominion Government has established in other Provinces. Trained and qualified men can of course alone carry on biological researches in such lakes as those of Manitoba, but the University of Manitoba will soon have men equipped for such work, and on the professoriate are already men of distinction in various scientific fields, whose services could no doubt be secured were a biological station established. Two members of the commission had the advantage of meeting Sir John Murray in Winnipeg, and he was enthusiastic as to the splendid field awaiting scientific investigation in the Manitoba lakes. A biological station seems a necessary and desirable institution for aiding the fisheries and as a commission, we would urge such a station as a pressing need."

Since these words were written, more than eight years have passed, and no steps have yet been taken to give practical effect to the urgent appeal of the commission. While biological stations have been established on the eastern and western seaboard of the Dominion, there is yet no station where the habits of the fish of the inland waters of Canada may be studied. The Province of Manitoba occupies a strategic position, not only because of the extent of the larger lakes—Winnipeg, Manitoba, Winnipegosis, and Lake of Woods—wholly or partly within its boundaries, but also because of the importance of the rivers—Red River, Winnipeg River, Saskatchewan River, Nelson River—with their numerous fish-bearing lakes, which deploy into, or flow through Manitoba territory. The University of Manitoba is now in a position to supply not only the zoologists who would direct the

researches in such a station, but also the botanists, physiologists, geologists and chemists, whose investigations would materially assist in many of the problems which await solution. It will suffice to refer in this place to only two points. In the time of the early explorers, sturgeon were abundant in the Nelson River, Lake Winnipeg, and in the Winnipeg and Red Rivers. Today, even after a prolonged close season for sturgeon, reports from all quarters indicate a marked scarcity in the numbers of this magnificent fish. The habits of the sturgeon in our inland waters are all but unknown. No doubt practical difficulties will be discovered in the course of any investigation which has for its object the replenishing of our northern waters by means of sturgeon hatcheries. It seems to be difficult, for example, to procure the ripe male and female spawn at the same time. If such difficulties were overcome, and if the king of the inland waters should regain his pristine supremacy, there would be made possible an industry of first importance for the northland in the fishing of sturgeon and the manufacture of caviare. Again, were it found by experiment that sporting fish such as the black bass could be introduced into Manitoba waters without detriment to the rights of the native fish, the northland would become the Mecca of the angling fraternity, and many a lake and waterfall which, it would seem, has been born to blush unseen, would give delight to others than the few travellers to whom it has been permitted to feast on their indescribable beauty.

CONDITIONS AFFECTING WILD LIFE

Trappers and sportsmen are well aware that a very definite, and to a certain extent periodic, fluctuation is to be observed in the abundance of the wild life of the woods. The best known case is that of the rabbit, which practically disappears from our forests every seven or eight years. The elimination of a staple article of food affects the equilibrium which is to a certain degree maintained among the denizens of the wilds, and a well-defined minimum in

the case of other animals follows on the heels of the rabbit famine. Wolves turn their attention more exclusively to the deer, which suffer seriously in consequence; and doubtless other readjustments take place, the extent of which is as yet imperfectly understood. At the present time the wolf menace is serious. To what extent this is the direct outcome of a marked scarcity of rabbits it would be important to ascertain. Recent investigations by Dr. Hewitt, the Dominion entomologist, establish the fact that the periodical disappearance of the rabbit is to be attributed to the work of a parasite which attacks the rabbit. Whether this parasite is the direct cause of pathological conditions in other animals it would be interesting to determine. At any rate, the science of parasitology would seem to have an important bearing on the preservation of wild life, and as a consequence on the fur and big game industry. The wolf menace, to which reference has been made, may require legislative action. Before any such action is taken, however, the whole question of the habits of the wolf in relation to the deer should be made a subject of study. The abundance or otherwise of the deer can hardly be gauged from the results of the observations of one winter. It may well occur that new routes of travel are taken, and that the apparent scarcity is not real. An expedition to the northern breeding grounds of the deer might collect valuable information as to the destruction of deer by the wolves, and, if necessary, take measures to exterminate the menace.

INTRODUCTION OF EUROPEAN REINDEER

Apart from the domestic animals of the farm, little has been done in Canada to vary the fauna by the introduction of new species. The attempt to introduce the reindeer of Lapland into the barren and moss-covered territory of northern Canada is not without interest for northern Manitoba. To the Lap the reindeer is not only food and clothing, but the vehicle of transportation as well. The herd introduced into Alaska by the United States Govern-

ment now numbers over 13,000, that of Newfoundland 1,200. Recently some animals have been transported to Fort Smith on the Mackenzie valley, and may prove to be the forerunners of a successful herd in that district. A considerable section of the barren lands now falls within the confines of northern Manitoba, and is inhabited by migratory bands of Eskimo, who eke out a very precarious existence. It may be found that the European reindeer are more amenable to domestication in that territory than are their near relatives the barren land caribou, and that their presence will not disturb the caribou. It is improbable that interbreeding will take place, and a new type will be produced, which, while an animal of domestication, will be more at home than the reindeer. There is little doubt that the reindeer will be introduced. Were the experiment successful, the conditions would be rendered so much the more favorable to the Eskimo in our northern territories.

FOX FARMING IN

The fur industry can be greatly stimulated by breeding some of the most valuable fur-bearing animals—the fox, marten, mink, fisher, raccoon, and others—in captivity. The fox farming industry, the success of which has been demonstrated in Prince Edward Island, has not yet been carried on on a large scale in Manitoba. Only three or four such farms have been established, and the venture has not been in every case successful. The main reason for this is the establishment of a numerical superiority of silver foxes, the pelts of which have commanded fancy prices in the London market. Climatic conditions would seem to be favorable in our territory, and there is an interesting field for the animal breeder as well as a promising outlook for the farmer, in this aspect of an industry with which the Province has long been identified.

UTILIZATION OF WATER POWER

Two phases of the utilization of waterpower have already been discussed, namely, the smelting of copper

sulphides and the production of fertilizers by the fixation of atmospheric nitrogen. In the cyanamide process of nitrogen fixation, calcium carbide would also be produced, the pure limestone of the Lake Manitoba horizon being available for this purpose; and a carbide industry might be developed in connection with the main business of producing fertilizers. Space does not permit a discussion in detail of other uses of power, such as in the pulp industry, the electrification of railways on lines where the density of the traffic would make this means of supplying energy financially feasible, or the extension of power into rural districts, though the time seems hardly ripe for such distribution in Manitoba. The thoughts of the leaders of industry in our Province will inevitably be focussed more and more on this vast potential resource; and one may rest assured that every scheme of waterpower development that holds out even a promise of success will be given the chance to succeed.

The Significance of Northern Manitoba*

We have discussed in some detail a few of the questions which arise in connection with the public domain in this Province. There are many others, but enough has been written to indicate at least the many-sidedness of the situation. It will be observed that emphasis has been laid, though not, it is believed, unduly, on the less developed and less understood territory in northern Manitoba, and the resources connected therewith. When, in 1912, the Province acquired an additional area of some 178,000 square miles, thus increasing the extent of its territory to more than three times its former area, it assumed a

* For detailed information the following publications should be consulted:
 The Hudson Bay Road. A. H. de Tremaudan.
 Northern Manitoba. J. A. Campbell.
 The Basins of the Nelson and Churchill Rivers. W. McInnes.
 (Geol. Surv. Can.)
 The Amisk-Athapapuskow Lake Districts. E. L. Bruce. (Geol. Surv. Can.)
 The New Manitoba District. F. H. Kitto. (Natural Resources Intelligence Branch, Dept. of Interior.)

responsibility commensurate with the territorial expansion. The increase in population was relatively small—8911 in the census of 1916—of which some 4,000 are native Indians, and a considerable proportion of the white population was engaged in constructional work on the Hudson Bay Railway and docks. The natural resources remained, as before, under the control of the Federal authorities. It might seem that the only practical change was a realignment of the boundaries of the territory, to be known as Manitoba. In actual fact, however, the significance of the realignment of territorial boundaries was far-reaching. A railway line to the sea will now lie in all-Manitoba territory. The importance of this much-discussed railway is far greater, for the Province and for the West, than certain eastern financial interests would freely admit. For northern Saskatchewan and northern Alberta its significance will depend on the amount of grain which will be carried to the port on the Bay, en route for the European markets; and it may be remarked in passing that one is forced to the conclusion, after an examination of all that has been written about the navigability of the Hudson Bay Straits, that such difficulties as have been referred to by the navigators have been magnified in certain quarters, and that the value of wireless communication and other aids to safe navigation have sometimes not been given due weight. Only a relatively small section of our Province will participate directly in the traffic in grain along the new route. The value of the railway, as far as Manitoba is concerned, lies rather in the fact that a large area, directly tributary to the railway, is opened up to communication; and the resources hitherto dormant, because of their inaccessibility, will become feeders of industries as the population increases, and as capital for investment in our raw materials becomes more readily available. Not only is the railway belt itself brought within reach of communication, but the waters of the Bay and the west coast, as far north as Chesterfield Inlet, become directly accessible as well. On the section of the railway thus

far constructed, transportation has been limited and freight charges high; yet the stimulus to the fishing industry, to prospecting, and to actual mining, has already been very real. From every point of view, it is imperative that the construction of the railway be pushed to a conclusion as soon as the financial conditions of the country will permit.

There has been a tendency, natural, perhaps, but none the less regrettable, to emphasize the mere extent of the north-land of northern Manitoba. Broad acres in themselves while they may add to our dignity as a Province, demand the expenditures necessary to maintain that dignity in good standing. Were there no actual resources in the northern area, or were the resources in that territory permitted to lie dormant, Manitoba would unquestionably have been richer in the long run had it remained in the humble position of the postage stamp Province. The value of the north-land is in part being substantiated. The expectations are already high. It will be more and more necessary, as development proceeds, that a sympathetic and intelligent interest be maintained in the welfare of the northern hinterland. This is all the more needed because the personal touch is limited. The main routes of travel lie east and west. Too few spend their vacations in the north country, albeit the pleasure and satisfaction to be derived from such a holiday is very real; for the romance that once was of the whole West is now of the north alone. There is a danger, to modify the words of the poet, that: "North is north, and south is south, and never the twain shall meet." There are two fundamental facts, however, that one may with a measure of confidence believe will not be lost sight of by the people of this Province. The one is that, in order to round off the industrial life of the community, new resources must be tapped, and to such resources the north-land in all probability holds the key. The other is that only with the intelligent co-operation of all the people can be initiated the enterprises necessary for the successful development of such resources.

